H104 3D Methodology Used for Exclusionary Identification at Crime Scenes—Who Was and Who Wasn't Here?

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After attending this presentation, attendees will learn about a morphometric technique for collecting a simple series of intra-hand measurements from photographic evidence and for analyzing these measurements in three dimensions for the purpose of establishing exclusionary identification.

This presentation will impact the forensic science community by showing results from a study to determine inter-observer error for this morphometric technique, expand the scope to include population variability, and examine the comparison of mono- and dizygotic twins to the robustness of this exclusionary technique.

The results of the study presented represent a step toward peer review for the described morphometric technique to broaden its utility in court. This technique was developed for a case in which the defendant claimed his older brother, a convicted child abuser, was the perpetrator of rapes against their 2-year-old niece. The rapes were recorded in a series of photographs that the Federal Bureau of Investigation determined to have been taken on two separate dates and in a videotape that occurred on the same date as one of the sets of photos; there was no DNA or dermatoglyphic evidence collected in this case. The prosecutor sought to add to the list of charges against the defendant by identifying whose hands were depicted in the photos, which for the most part showed an adult's fingertips and the victim's anatomy. The judge allowed the analysis to continue and ruled that the results were scientific in nature; however, he eventually did not admit the results into evidence at trial because the technique had not been peer-reviewed, which could have been a basis for appeal by the defendant.

When photographic imagery is introduced into evidence, one of the difficulties encountered can be the identification of subjects present or absent at the crime scene, absent the gold standard of results from DNA. The measurements of intra-hand landmarks described in this presentation are valuable in that they: (1) are conserved against weight gain and weight loss; (2) become fixed at maturity; and, (3) are easy to take. Such information is currently gathered in hand scanners and analyzed in two dimensions to establish identification for access to secure facilities. These landmarks represent conserved proportional relationships in adults; at maturity (~ 18 years), the growth of the digits, palm width, and other key aspects are established for life. For example, there are now several hundred articles addressing one feature used in our analysis: the relationship of 2^{nd} to 4^{th} digit length, a marker of intrauterine testosterone. Preliminary results from the above-referenced court case suggest that a 3D analysis enables unique identification of individuals. How unique? This presentation seeks to establish that.

The described procedure involves taking standard measurements of the hands in the photographic evidence, scaling them, and then statistically comparing them. This shape analysis relies on proportional relationships which also overcomes problems of scale and parallax. The scaled images are measured and then a Generalized Linear Model (Principal Component Analysis (PCA)) is used. When data are sufficient, the analysis allows differentiation of persons of interest based on the pattern unique to the individuals. In the proprietary report compiled for the prosecution in the child abuse case described, this pattern does not approximate the certainty level commonly derived from identifications derived from DNA or dermatoglyphs; however, the results showed the individual least likely present at the scene was the brother whom the defendant accused ($p<.031$). It is suggested that application of this technique will have broad-reaching implications in both the conviction of the guilty and exculpatory evidence for those not involved.

3D Morphometrics, Exclusionary, Identification

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